

CLAIMS

1. A processor system comprising a plurality of resource nodes connected to a network, a plurality of control nodes connected to the network, and a plurality of controllers, wherein

each of the resource nodes includes a resource holding unit for holding a plurality of resources and a resource information holding unit for managing the states of the resources, each state indicating that the corresponding resource is in a free or locked state,

each of the control nodes includes a plurality of control devices for issuing a plurality of requests associated with resources, each control node, including the control devices which have issued requests, transferring the requests to the corresponding controller, and wherein

at least one controller, which has received the requests, issues a request message to each of resource nodes which hold target resources associated with the requests,

each resource node which has received the request message checks that the target resource is in the free state, changes the state of the target resource to the locked state, and issues a permission message to the at least one controller,

the at least one controller, which has received the permission message, checks that all of permission messages associated with other requests preceding the corresponding request received by the at least one controller have already been received and issues an update message to the resource node which holds the target resource associated with the corresponding request, and

the resource node which has received the update message changes the state of the target resource to the free state.

2. The processor system according to claim 1, wherein
the controllers are included in the control nodes, respectively, and
the controller in each control node includes a selector for arranging the requests issued by the control devices in the control node.
3. The processor system according to claim 1, wherein
the controllers are connected to the network, and
each control node includes a selector for arranging the requests issued by the control devices in the control node.
4. The processor system according to claim 1, wherein
the controllers are included in the resource nodes, respectively, and
each control node includes a selector for arranging the requests issued by the control devices in the control node.
5. The processor system according to claim 1, wherein
the resource nodes and the control nodes are combined into a plurality of nodes, respectively, and
each node includes a selector for arranging the requests issued by the control devices in the node.
6. The processor system according to any one of claims 1 to 5, wherein
each controller includes a release processing unit,
each resource node which has received the request message issues a release-request message to the at least one controller when the target resource is in the locked state,
the release processing unit in the at least one controller starts a release process in response to the received release-request message,
the release process includes:
a step of issuing a request message to the resource node which holds the target resource associated with the corresponding request;
a step of stopping accepting of a new request; and

a step of issuing a release message to each of resource nodes which hold target resources associated with requests following the corresponding request received by the at least one controller when permission messages associated with the following requests have already been received or are received during the release process, and

when receiving a permission message sent in response to the release-request message, the at least one controller terminates the release process.

7. The processor system according to any one of claims 1 to 5, wherein each state managed by the resource information holding unit includes an interruptible locked state and a request-locked state,

the at least one controller, which has received the request, issues a weak request message when all of permission messages associated with other requests preceding the request received by the at least one controller have not yet been received,

the resource node which has received the weak request message checks that the target resource is in the free state, changes the state of the target resource to the interruptible locked state, and issues a permission message to the at least one controller,

the interruptible locked state includes information to specify the at least one controller,

the resource node which has received the request message issues an inhibition message to the at least one controller when the target resource is in the locked state,

the resource node which has received the weak request message issues an inhibition message to the at least one controller when the target resource is in the locked state or the interruptible locked state,

the at least one controller which has received the inhibition message issues a request message when all of permission messages associated with

other requests preceding the request received by the at least one controller have already been received, or issues a weak request message when all of the permission messages have not yet been received,

when the target resource is in the interruptible locked state, the resource node which has received the request message changes the state of the target resource to the request-locked state and then outputs a retry-request message to a controller designated by the information included in the interruptible locked state,

the controller which has received the retry-request message executes a retry process,

the retry process includes:

a step of specifying a request associated with the target resource;

a step of issuing a release message to the resource node which holds the target resource associated with the specified request; and

a step of changing the state of the specified request to a state in which a permission message associated therewith has not yet been received when an update message has not yet been issued in response to the specified request, and issuing a request message when all of permission messages associated with other requests preceding the specified request received by the controller have already been received, or issuing a weak request message when all of the permission messages have not yet been received, and

the resource node which has received the release message changes the state of the target resource to the locked state and issues a permission message to the at least one controller.

8. The processor system according to claim 1, wherein

each of the resource nodes is a processor node having a plurality of processors,

each of the processor nodes includes a main memory serving as the

resource holding unit, a directory serving as the resource information holding unit, and a memory controller connected to the processors, the main memory, and the directory,

each of the control nodes is an input/output node including a plurality of input/output devices serving as the control devices, and

each of the controllers is an input/output controller.

9. A method for processing access, the method being applied to a processor system including a plurality of resource nodes connected to a network, a plurality of control nodes connected to the network, and a plurality of controllers, each of the resource nodes including a resource holding unit for holding a plurality of resources and a resource information holding unit for managing the states of the resources, each state indicating that the corresponding resource is in a free or locked state, each of the control nodes including a plurality of control devices for issuing a plurality of requests associated with resources, the method comprising the steps of:

transferring requests to at least one corresponding controller;

issuing a request message to each resource node which holds the target resource associated with the corresponding request,

checking that the target resource is in the free state, changing the state of the target resource to the locked state, and issuing a permission message to the at least one controller;

checking that all of permission messages associated with other requests preceding the corresponding request received by the at least one controller have already been received and issuing an update message to the resource node which holds the target resource associated with the corresponding request; and

changing the state of the target resource to the free state.

10. The method for processing access according to claim 9, further comprising the step of:

arranging the requests issued by the control devices in each control node.

11. The method for processing access according to claim 9, further comprising the steps of:

combining the resource nodes and the control nodes into a plurality of nodes, respectively; and

arranging the requests issued by the control devices in each node.

12. The method for processing access according to any one of claims 9 to 11, further comprising the steps of:

issuing a release-request message to the at least one controller when the state of the target resource is in the locked state; and

starting a release process in the at least one controller which has received the release-request message, wherein

the release process includes the substeps:

issuing a request message to the resource node which holds the target resource associated with the corresponding request;

stopping accepting of a new request; and

issuing a release message to each of resource nodes which hold target resources associated with requests following the corresponding request received by the at least one controller when permission messages associated with the following requests have already been received or are received during the release process, and

the method further includes the step of terminating the release process in the at least one controller which has received a permission message sent in response to the release-request message.

13. The method for processing access according to any one of claims 9 to 11, wherein

each state managed by the resource information holding unit includes an interruptible locked state and a request-locked state,

the method further comprises the steps of:

issuing a weak request message when all of permission messages associated with other requests preceding the corresponding request received by the at least one controller have not yet been received; and

checking that the target resource is in the free state, changing the state of the target resource to the interruptible locked state, and issuing a permission message to the at least one controller,

the interruptible locked state includes information to specify the at least one controller,

the method further includes the steps:

issuing an inhibition message to the at least one controller when the target resource is in the locked state;

issuing an inhibition message to the at least one controller when the target resource is in the locked state or the interruptible locked state;

issuing a request message when all of permission messages associated with other requests preceding the corresponding request received by the at least one controller have already been received, or issuing a weak request message when all of the permission messages have not yet been received;

changing the state of the target resource to the request-locked state when the target resource is in the interruptible locked state, and outputting a retry-request message to a controller designated by the information included in the interruptible locked state; and

executing a retry process,

the retry process comprises the substeps of:

specifying a request associated with the target resource;

issuing a release message to the resource node which holds the target resource associated with the specified request; and

changing the state of the specified request to a state in which a permission

message associated therewith has not yet been received when an update message has not yet been issued in response to the specified request, and issuing a request message when all of permission messages associated with other requests preceding the specified request received by the controller have already been received, or issuing a weak request message when all of the permission messages have not yet been received, and

the method further includes the step of:

changing the state of the target resource to the locked state and issuing a permission message to the at least one controller.

14. The method for processing access according to claim 9, wherein each of the resource nodes is a processor node having a plurality of processors,

each of the processor nodes includes a main memory serving as the resource holding unit, a directory serving as the resource information holding unit, and a memory controller connected to the processors, the main memory, and the directory,

each of the control nodes is an input/output node including a plurality of input/output devices serving as the control devices, and

each of the controllers is an input/output controller.